U.S. Department
of Transportation

**National Highway
Traffic Safety
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400 Seventh Street, S.W.
Washington, D.C. 20590

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TRANSPORTATION SCIENCES CENTER
ACCIDENT RESEARCH GROUP

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CALSPAN ON-SITE SCHOOL BUS/PEDESTRIAN ACCIDENT INVESTIGATION
CALSPAN CASE NO. 95-6
SCHOOL BUS: 1989 BLUE BIRD TYPE D BODY
LOCATION:
DATE: 1995

Contract No. DTNH22-94-D-07058

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points are coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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SUMMARY

This on-site investigation focused on a injury accident that involved a 12 year old female pedestrian who was discharged from a school bus and subsequently contacted by the right rear tire of the bus. The pedestrian's jacket drawstring became caught in the handrail of the school bus as she exited the vehicle. Immediately following the pedestrian's departure from the bus, the school bus driver closed the manually operated bi-fold door and accelerated from the curbline. The school bus driver failed to visually track the position or check the location of the pedestrian in the right side convex mirrors prior to accelerating from the stop. The snagged drawstring pulled the jacket off the pedestrian and rotated her into the right side surface of the bus. The right rear tire contacted her right medial thigh and knocked her to the road surface. The pedestrian sustained a chip fracture of the right ankle, abrasions across the right flank and hip areas, and an abrasion of the right elbow. The bus driver observed the pedestrian's jacket in the right convex mirror and stopped the bus approximately 175' from the bus stop.

The accident occurred on a four lane street in the City of on 1995, at approximately 1534 hours. The school bus driver stopped the bus approximately 200' beyond the designated school bus stop to discharge three students. The driver cited heavy traffic and the close proximity of the designated bus stop to a four-leg intersection for the alteration of the bus stop location. At the time of the accident, the weather was clear and the road surface was dry.

The involved school bus was a 1989 Blue Bird, Type D bus with a rated capacity of 72 passengers. The bus was manufactured in 1989. and was identified by the following vehicle identification number (VIN): 1BAAGCSA0 In addition to the VIN, the bus body number was with a bus service number of The bus was equipped with three exterior mirrors mounted to the A-pillar on each side of the forward control bus. These mirrors included an 8" diameter convex mirror which provided the driver a view across the front of the bus, an 8" diameter convex mirror which provided the driver with a view of the respective side of the bus, and a 5.5 x 14.74" rectangular plane (flat) mirror which provided additional viewing along the side of the bus. The bus was also equipped with an interior *Audiocam* bus monitoring system. This system was in operation at the time of the accident and recorded the audio and video egress of the pedestrian (to the stairs of the bus) and the acceleration of the bus and detection of the pedestrian by the driver. (A copy of the VHS tape is provided with this summary).

The school bus was owned and operated by Transportation, a contractor to the School System. The handrail for the stairs on the school bus was an issue of a recall which involved the replacement of the diagonal rail. The original handrail was reported as a straight bar while the replacement rail was formed with curves at each end. The modification had been completed by Transportation prior to this accident. There was a second notice issued for the Blue Bird buses which directed the owners of the bus to bend the lower flange of the added bracket that attached the handrail to the floor of the bus and eliminated the void between the vertical rail and the stairwell. The Transportation Supervisor at Transportation stated that his company did not receive the second notification prior to this accident. They received notification after the accident and modified the square edges of the replacement handrail by grinding a radius at the flange where the rail is bolted to the retaining collar. This modification did not follow the notice issued by Blue Bird, however, the recommended procedure would not have prevented this accident. Transportation had completed this handrail modification on the four Blue Bird buses in their eighty-one vehicle bus fleet.

The driver of the bus was a 42 year old female with a height of 65" and weight of 165 lbs. She had been employed as a school bus driver since 1986, and has been a driver for Transportation since 1990. She had received the required driver training programs which includes a 6 hour in service training course each year. The driver was rated as an excellent bus driver by the Transportation Supervisor. She had two years of driving experience with the Blue Bird Type D buses and had been assigned to the accident involved bus and this bus route since the beginning of the school year. The driver holds a current CDL license with a restriction for corrective lenses. She noted that she has an astigmatism in her left eye which requires the prescription eyeglasses. The driver was wearing the glasses at the time of this accident.

The pedestrian was a 12 year old female with a measured height of 52" and estimated weight of 80 lbs. She was wearing denim jeans, white athletic shoes, a light colored blouse, and a oversize black leather jacket that was opened. The leather jacket contained a drawstring in the lower area of the jacket which extended below the jacket when worn to a point that was 11.5" above the ground. The drawstring was a braided cord that was approximately 3/16" in diameter and was 55.5" in length. The ends of the drawstring were fitted with a metallic bell-shaped end cover that was 7/16" in diameter and 0.5" in length. Directly above the end cover was a doughnut shaped adjustment tab that measured 0.75" in diameter and 0.25" in thickness. There was no damage to the drawstring or to the tabs located on the ends of the string. The pedestrian was also carrying a large book bag in her left hand as she exited the bus.

The school bus driver approached the right curbline approximately 200' beyond the designated drop point to discharge three elementary and middle school aged children. The provided video tape from the *Audiocam* system shows the interior of the bus as the driver approaches the bus stop. She stops the school bus at 4:34:31 o'clock. (It should be noted that the clock on the video tape is advanced by one hour than the actual eastern standard time.) The involved pedestrian immediately stood up from her seated position toward the rear of the school bus at 4:34:31 and used her right hand to adjust the right side of her jacket. At 4:34:34, the pedestrian began to walk up the center isle

toward the front of the bus. The video tape shows the pedestrian turn to her right at 4:34:41as she prepares to descend the four steps on the bus. At this point, the pedestrian leaves the field of view of the *Audiocam* as the remainder of the actions were recorded on the audio portion of the tape.

The driver began to closed the manually operated bi-fold door at 4:34:43 and accelerated from the curbline at 4:34:44. This time frame provided the pedestrian with approximately 2 seconds to walk down the four steps of the bus and exit the vehicle onto the sidewalk adjacent to the curbline. The driver continued to accelerate the bus as she steered to the left to gain access to the travel lane of the four lane road. The video tape provided a view of the environment through the buses' windows and indicated that the driver had accelerated for approximately 6 seconds.

As she was merging to her left, the bus driver checked the right side convex mirror and observed a black object hanging from the door of the bus. The audio tape recorded the driver's voice at 4:34:50 as identifying the accident event. She immediately braked and stopped the school bus at 4:34:52. Although the driver stated that she had traveled less than the length of the bus when she observed the pedestrian's jacket and stopped, the on-scene police photographs and witness statements placed the school bus approximately 175' beyond the bus stop and the final rest position of the pedestrian.

The *Audiocam* system did not record the pedestrian's actions as she descended the steps and exited the school bus. The metallic tab on the right side of her jacket's drawstring became snagged in the slot that was formed between the replacement handrail and the stainless steel clamp that attached the diagonally orientated handrail to the vertical support. This probably occurred as the pedestrian stepped onto the bottom step, or as she was exiting the vehicle. As noted from the videotape, the pedestrian was provided with a scant time interval (approximately 2 seconds) to descend the steps and exit the bus prior to the driver closing the door and accelerating from the curb.

The pedestrian's jacket was subsequently pulled by the accelerating school bus as the drawstring remained snagged in the handrail. The initial acceleration probably rotated the pedestrian in a clockwise direction and into the right side surface of the bus. The pedestrian dropped her book bag as her jacket was pulled off her body. Her mother stated that the jacket was found with the sleeves turned inside out, indicating that the jacket had been forcibly pulled off her body. She probably began to fall to the asphalt road surface and was contacted by the sidewall and edge of the tire tread of the right rear tire. This contact produced a patterned tire tread transfer that was longitudinally orientated on the medial aspect of the right thigh. The contact probably rotated the leg in a clockwise direction with loaded the pedestrian's right ankle resulting in a chip fracture of the ankle. Based on the injury to the ankle, it was possible that the ankle was bearing some of the pedestrian's weight, indicating that she was in an upright, or partially upright orientation when contacted by the tire.

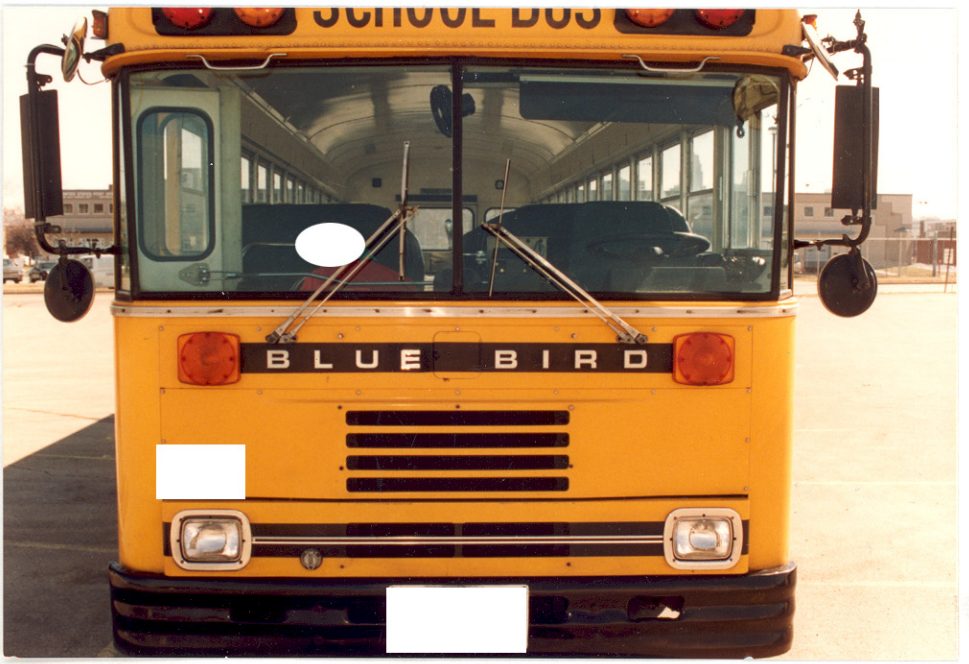
She was subsequently knocked to the asphalt road surface where she came to rest on her right side with her head pointing toward the centerline of the road and her feet near the curbline. Her contact with the pavement resulted in a 0.5" diameter abrasion on the right elbow and abrasion across the right hip and flank area.

The pedestrian's jacket drawstring remained attached to the handrail of the school bus as the vehicle came to rest. The investigating police officer observed the draw string in the handrail and photographed the engagement at the scene. There was no damage to the drawstring or to the pedestrian's leather jacket.

Causal Factors

The accident involved three major contributing factors. The first was the handrail which provided a slot between the flat end on the stainless steel rail and the clamp which attached the rail to the vertical support. This slot created a mechanism for the drawstring to become snagged in the hand rail. Secondly, the driver did not provide the pedestrian with sufficient time to clear the bus before closing the door and accelerating from the curb. In addition, she failed to visually track the students as they exited the bus to ensure that they had cleared the vehicle prior to departing from the bus stop. Furthermore, the bus driver failed to check the vehicle's mirrors for pedestrian's prior to accelerating from the bus stop. She did check the right side convex mirror approximately six seconds into the acceleration mode, however, at this point in time, the accident had already occurred.

The post-accident modification of the handrail is not a successful remedy to the potential snagging of a drawstring or similar object. During the course of our on-site investigation, we passed a jacket drawstring along the modified hand rail of the involved Blue Bird school bus and the leather tab at the end of the drawstring became snagged at the junction of the handrail and its attachment point with the vertical support. (Refer to preliminary photograph nos. 10-13.) The radius that was ground to the upper and lower surface of the flat end of the rail did not eliminate the void that snagged the drawstring.



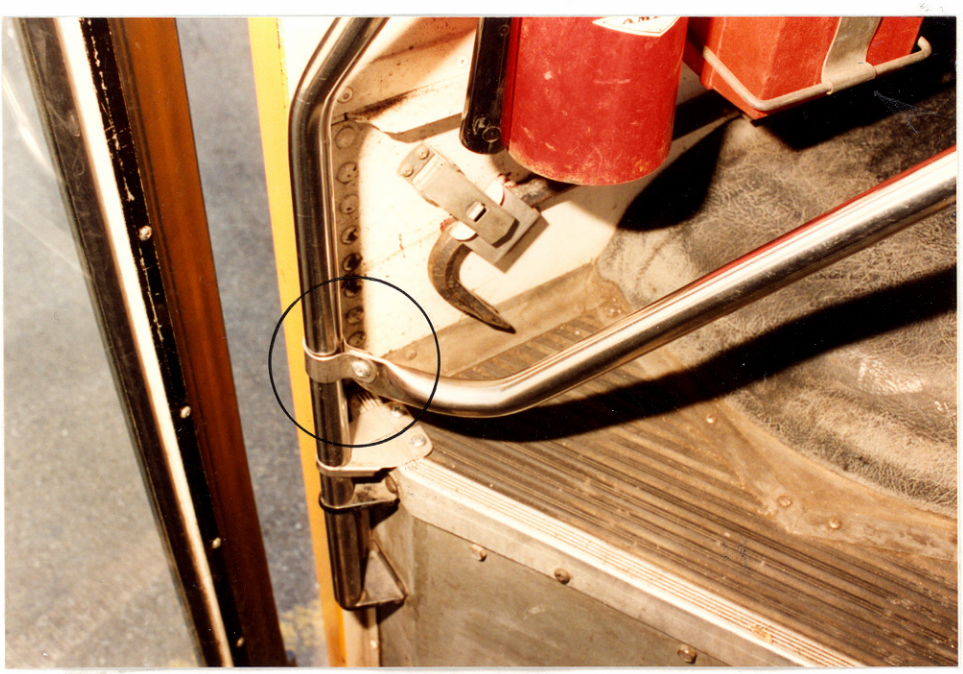
1. View of the frontal plane of the Type D (Forward Control) School Bus manufactured by Blue Bird.

2. Overall view of the right side plane of the School Bus.

3. Longitudinal view of the right side looking rearward from the leading edge of the egress door.

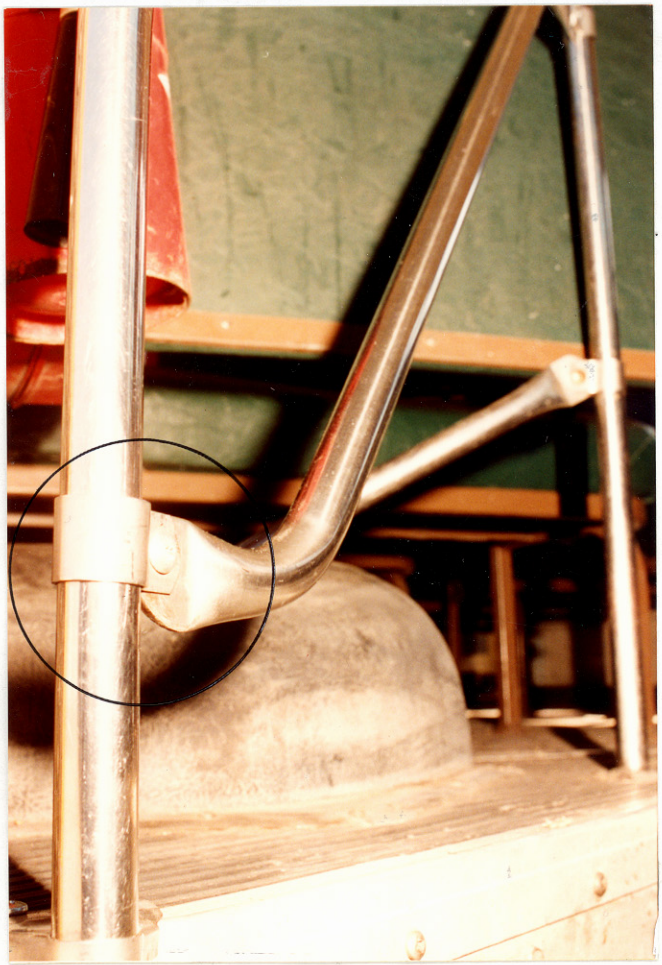
4. Photograph depicts the conspicuity of the pedestrian in the lower convex mirror.

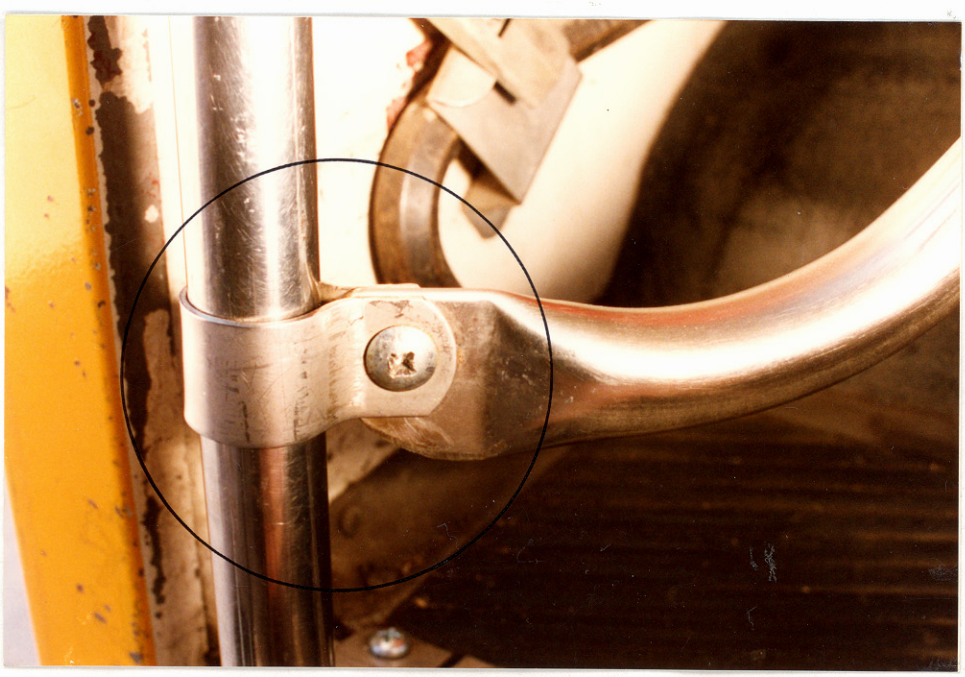
5. View of the handrail system along the right side (rearward side) of the stair well.



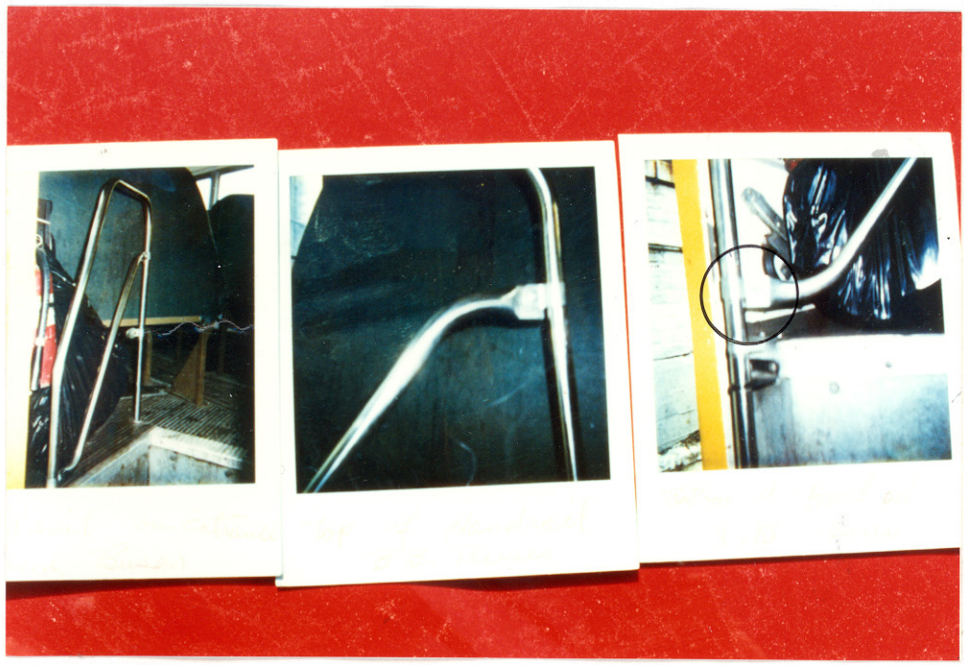
6. Closer view of the post event modification to the lower aspect of the replacement handrail showing the attachment bracket with the upper handrail adjacent to the egress door opening.

7. View of the post event modification of the lower aspect of the replacement rail at the junction of the attachment bracket looking inward from outside of the School Bus.





8. Close-up view of the lower rail attachment showing a rounded lower edge which was modified from a square edge after this event.



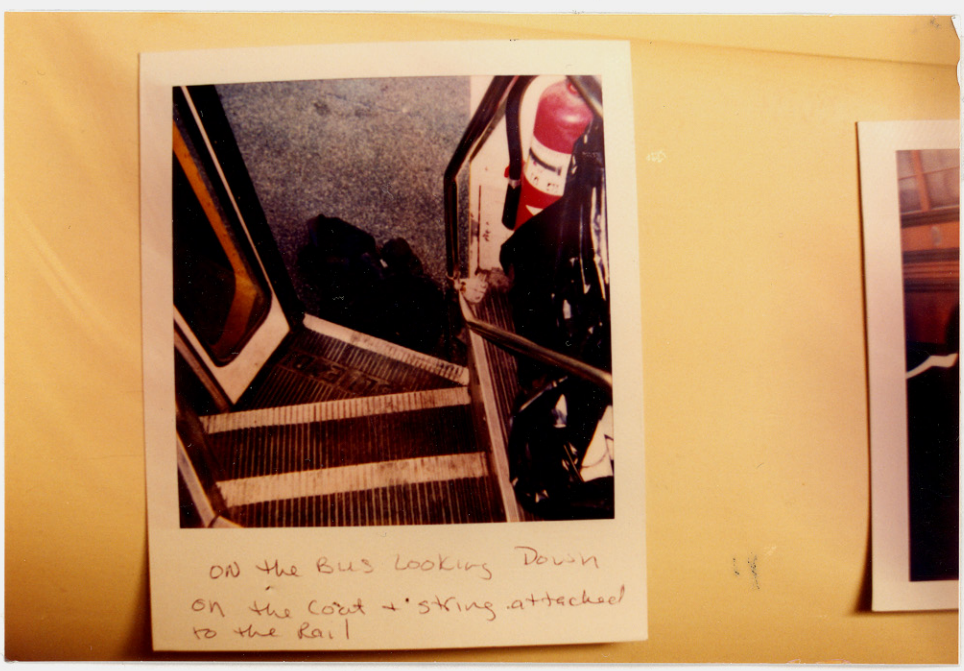
9. Views of the lower replacement handrail prior to post event modification.

10. Simulation of the drawstring snag in the junction of the lower replacement handrail and attachment bracket.

11. Closer view of the simulated drawstring snag in the junction of the lower replacement handrail and attachment bracket.

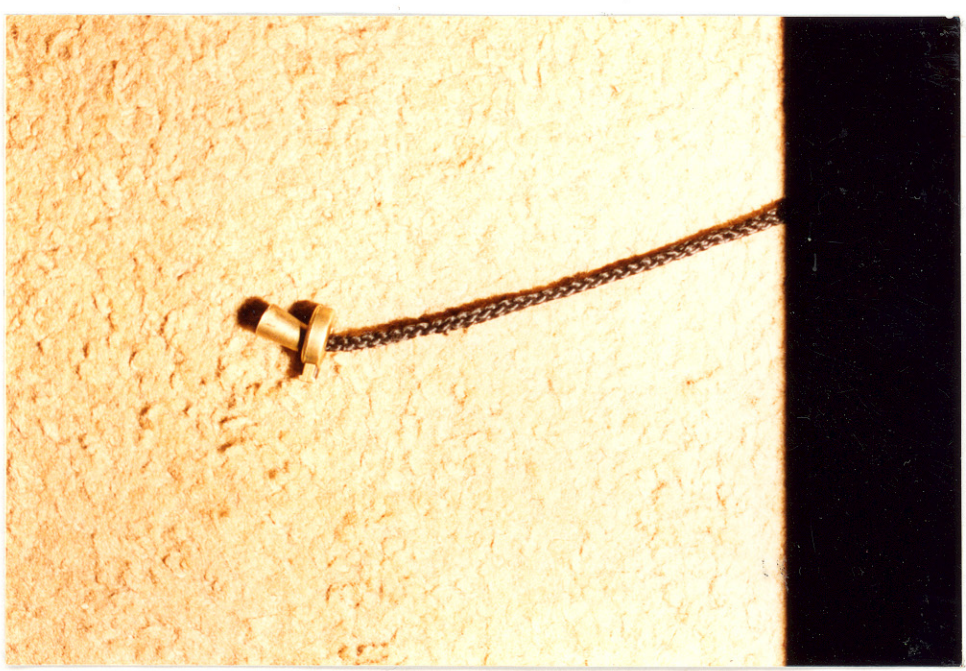
12. View of the simulated drawstring snag from outside of the School Bus.

13. Close-up view of the simulated drawstring snag highlighting the leather slack adjuster as the snagging agent.



14. On-scene photograph of the drawstring caught in the junction of the lower replacement handrail and attachment bracket. The pedestrian's coat is located on the ground at the base of the stairs.

15. View of the pedestrian's right leg showing a tire imprint mark.



16. View of the pedestrian's drawstring slack adjuster which was caught in the junction of the lower replacement handrail and attachment bracket.